

REMARKS

Applicants respond to the Office Action of September 21, 2005 as follows:

The Examiner has acknowledged the Applicants' election without traverse of Group IA, claims 1-3 and 5-16. Claims 4 and 17-34 are withdrawn as directed to a non-elected invention.

Objection to the Specification

The Examiner has objected to the following sentence on page 13, lines 4-5: "The optical device 30, such as a fiber grating (which is a mirror), coupled after the Faraday rotator 25 not is transmissive." In order to clarify the meaning of this sentence, it has been reworded as indicated in the above amendment.

Amendment to the Drawings

Applicants propose a minor corrective amendment to Fig. 2b. A replacement sheet is submitted as required by 37 C.F.R. § 1.121(d).

Clarifying Amendments to the Claims

Applicants amend each of the claims to refer to a "chirped pulse amplification system," instead of "the chirped pulse amplifier" or "the amplifier." The amendment improves the clarity and consistency of the claims that refer to an amplifier as an element of the chirped pulse amplification system, such as claims 5, 10, and 16.

Claim Rejections Under 35 U.S.C. § 112, Second Paragraph

Claims 10, 12, 13, and 16 have been rejected under 35 U.S.C. § 112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter that the Applicants regard as the invention.

The Examiner maintains that the term “erbium/ytterbium” in claim 10 is indefinite, because it is unclear whether the slash means “and” or “or.” In order to clarify that this amplifier is doped with both erbium and ytterbium, Applicants have amended claim 10. It is noted that “erbium/ytterbium” or “Er/Yb” are terms of art referring to the combination of the two dopants.

The Examiner also maintains that there is insufficient antecedent basis for the limitation “the polarization beam splitter” in claims 12 and 13, and states that the term “fiber axis” in claims 12 and 13 refers to the polarization axis, not the optical propagation axis of the light. Suitable clarifying amendments have been made in light of the Examiner’s suggestions.

In addition, the Examiner argues that there is insufficient antecedent basis for the limitation “the optical device is transmissive” in claim 13, because it does not specify which optical device is transmissive. Again, appropriate clarifying amendments have been made, and in addition, Applicants have added new claim 35, which incorporates a Faraday rotator mirror at a first port of the beam router.

Finally, claim 16 has been amended to clarify the scope thereof, as requested by the Examiner.

Claim Rejections Under 35 U.S.C. § 102(b)

Claims 1 and 2 have been rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by U.S. Patent No. 4,928,316 to Heritage et al. (hereinafter “Heritage”). Applicants traverse the Examiner’s rejection of these claims.

Independent Claim 1

Independent claim 1 recites a chirped pulse amplification system comprising “a mode-locked laser; and a pulse selector coupled to an output of the mode-locked laser, wherein the pulse selector modulates an output stream of pulses based upon an applied modulation voltage.”

The Examiner maintains that Heritage teaches all of the elements of claim 1. Heritage discloses an optical system for shaping ultrashort pulses (col. 4, lines 44-45). Heritage achieves pulse shaping by stretching the optical pulses, modulating the stretched frequencies, and compressing the modulated frequencies into the desired pulse shapes (col. 4, lines 46-51). In particular, as shown in Fig. 1, Heritage uses a mode-locked laser (1) to produce an ultrashort pulse (2). The temporal pulse stretcher (3) produces a longer chirped pulse (4), which has frequency components that arrive at the high-speed modulator (5) at different times (col. 5, lines 40-48). The modulator (5) is used to manipulate the amplitude and/or phase of the individual frequency components arriving at different times (col. 5, lines 48-52). The modulator (5) can be various types of electro-optic modulators (col. 7, line 66 – col. 8, line 4). A programmable microwave signal generator (7) generates a shaped microwave pulse (6) that drives the

modulator (5) (col. 5, lines 52-54). The chirped shaped pulse (8) is then compressed to its original pulse width by the compressor (11) (col. 5, lines 59-63). Heritage suggests that the stretched pulse can be amplified anywhere between the pulse stretcher (3) and the pulse compressor (11) (col. 7, lines 32-36).

Heritage does not anticipate the claimed invention. Heritage does not disclose a chirped pulse amplification system “wherein the pulse selector modulates an output stream of pulses based upon an applied modulation voltage,” as required by claim 1 (emphasis added). A pulse selector or “pulse picker”, as it is commonly known, reduces the frequency of a pulse train. Clearly, Heritage does not disclose a pulse selector. The modulator (5) of Heritage manipulates the shape of each individual pulse, but does not change the frequency of the pulse train. Also, the modulator (5) of Heritage is driven by a shaped microwave pulse (6) that is selected to produce the desired amplitude and/or phase modulation on the chirped, stretched pulse (4), not by an applied modulation voltage as claimed.

At least by virtue of the aforementioned differences, Applicants’ claim 1 distinguishes over Heritage. Claim 2 is a dependent claim including all of the elements of independent claim 1. Therefore, at least because of its dependency, claim 2 is patentable over Heritage.

Claim Rejections Under 35 U.S.C. § 103(a)

Claim 3 has been rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Heritage in view of U.S. Patent No. 5,463,647 to Pan. Applicants traverse the Examiner’s rejection of this claim. Claim 3 is a dependent claim including all the elements of independent

claim 1 and dependent claim 2. Therefore, at least because of its dependency, claim 3 is patentable over Heritage. Moreover, Pan does not supply the teachings missing from Heritage, in that Pan's lithium niobate modulator is being used as a phase control device (somewhat similar to Heritage in effect), and is not a pulse selector as claimed.

Claims 5-15 have been rejected under § 103(a) as allegedly being unpatentable over Heritage in view of U.S. Patent No. 6,885,683 to Fermann et al. (hereinafter "Fermann"). Applicants traverse the Examiner's rejection of these claims.

Independent Claim 5

Independent claim 5 recites a chirped pulse amplification system comprising:

“a mode-locked laser;

a polarization-maintaining device coupled to an output of the mode-locked laser;

a pulse stretcher coupled to a first output of the polarization-maintaining device;

an amplifier coupled to the pulse stretcher; and

a first pulse selector coupled to a second output of the polarization-maintaining device.”

The Examiner acknowledges that Heritage does not disclose a polarization-maintaining device coupled to an output of the mode-locked laser. However, the Examiner argues that Fermann uses polarization-maintaining optical fiber between the mode-locked laser and the pulse stretcher. The Examiner further claims that it would have been obvious to an optical engineer to

place the modulator of Heritage between the second output of the polarization-maintaining fiber and the pulse stretcher in Fermann, in order to select maximally amplified pulses.

Heritage is described in the above discussion relating to independent claim 1. Fermann discloses a modular laser system that generates high peak and high average power ultrashort pulses (abstract). Fig. 1 of Fermann shows that pulses generated by a femtosecond laser source (5) are coupled into a pulse stretcher (6), where they are dispersively stretched in time (col. 6, line 50 – col. 7, line 2). The stretched pulses are then amplified by a ytterbium fiber amplifier (7), and compressed by the pulse compression module (4) (col. 6, line 53 – col. 7, line 5). The pulse stretcher (6) is a length of fiber that is coupled to the laser source (5) by fusion splicing (col. 6, line 67 – col. 7, line 2). All fibers in Fermann are preferably polarization-maintaining (col. 7, lines 7-8).

Heritage in view of Fermann does not render claim 5 obvious. As discussed above, contrary to the Examiner's assertion, Heritage does not disclose a pulse selector. In addition, Fermann does not disclose a polarization-maintaining device with a first output coupled to a pulse stretcher, and a second output coupled to a first pulse selector, as required by claim 5. The Examiner argues that the fiber connecting the laser source (5) with the pulse stretcher (6) in Fermann is a polarization-maintaining device. However, this length of fiber only has a single output, which is coupled into the pulse stretcher (6). This length of fiber has no second output. Therefore, neither Fermann, Heritage, nor their combination suggest the configuration of claim 5. Because claims 6-15 are dependent upon independent claim 5, they are also patentable over Heritage in view of Fermann.

With specific regard to dependent claim 10, the chirped pulse amplification system comprises a wavelength division multiplexer (WDM). In rejecting this claim, the Examiner maintains that Fig. 9 of Fermann discloses a WDM. The Examiner is in error. Neither Fig. 9 nor its corresponding text (col. 12, line 5 – col. 13, line 29) disclose a WDM, and the Examiner does not particularly point out which reference number corresponds to the alleged WDM in Fermann. Therefore, dependent claim 10 is patentable over Heritage in view of Fermann.

With further regard to dependent claims 12 and 13, the Examiner argues that non-polarization maintaining dispersion shifted fiber is well known in the art of optical engineering. However, dependent claims 12 and 13 do not contain such an element. Accordingly, the Examiner's comments are not understood.

With further regard to dependent claim 14, the chirped pulse amplification system further comprises “a synchronization controller that synchronizes the first pulse selector with the second pulse selector” (emphasis added). Applicants submit that the Examiner is in error, in that Fermann fails to disclose such a synchronization controller

Independent Claim 16

Claim 16 has been rejected under § 103(a) as allegedly being unpatentable over Fermann in view of Heritage. Applicants traverse the Examiner's rejection of this claim. Independent claim 16 recites a chirped pulse amplification system that comprises:

“a mode-locked laser;

a polarization-maintaining device coupled to an output of the mode-locked laser;

a pulse stretcher coupled to a first output of the polarization-maintaining device;

a first amplifier coupled to the pulse stretcher;

a pulse selector coupled to the first amplifier; and

a second amplifier coupled through a beam splitter to a second output of the polarization-maintaining device.”

In rejecting claim 16, the Examiner maintains that Fermann teaches all of the elements of claim 16, with the exception of a mode-locked laser. However, the Examiner argues that it would have been obvious to an optical engineer to incorporate Heritage’s mode-locked laser into the laser system in Fermann to produce pulses periodically in time.

Fermann in view of Heritage does not render claim 16 obvious. Fermann does not disclose a polarization-maintaining device with a first output coupled to a pulse stretcher, and a second output coupled through a beam splitter to a second amplifier, as required by claim 16. As discussed above, the Examiner argues that the fiber connecting the laser source (5) with the pulse stretcher (6) in Fermann is a polarization-maintaining device. However, this length of fiber only has a single output, which is coupled into the pulse stretcher (6). This length of fiber has no second output. Therefore, neither Fermann, Heritage, nor their combination renders claim 16 obvious.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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23373

CUSTOMER NUMBER

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AMENDMENTS TO THE DRAWINGS

Fig. 2b has been amended to remove a misplaced arrow pointing to the left from the optical device (30).

Attachment: One (1) Replacement Sheet (FIG. 2b)